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Stress, development and mental health study, the follow-up study of Finnish TAM cohort from adolescence to midlife: cohort profile

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ABSTRACT

Purpose This cohort profile describes the Stress, development and mental health study (TAM), which is a cohort study investigating risk and protective factors as well as longitudinal associations regarding mental health and well-being from adolescence to midlife. This interdisciplinary cohort study operates, for example, in the fields of public health, social medicine, psychiatry and the life course perspective.

Participants In 1981 (n=2242, 98.0% of the target population), 1982 (n=2191, 95.6%) and 1983 (n=2194, 96.7%) during school classes, surveys were conducted to all Finnish-speaking pupils (mostly born 1967) in the Tampere region in Finland. Participants of the school study at age 16 in 1983 (n=2194) comprised the base population for the longitudinal data and were followed-up using postal questionnaires in the years 1989, 1999, 2009 and 2019 at ages 22 (n=1656, 75.5% of the age 16 participants), 32 (n=1471, 67.0%), 42 (n=1334, 60.8%) and 52 (n=1160, 52.9%).

Findings to date The self-reported questionnaires include information on physical and mental health (eg, depression and mood disorders, anxiety disorders), health behaviour and substance misuse (eg, alcohol, tobacco and exercise), socioeconomic conditions, psychosocial resources (eg, self-esteem), social relationships and support, life events, etc. The numerous studies published to date have examined mental health and various factors from several perspectives such as risk and protective factors, individual developmental paths (eg, trajectories) and pathway models (mediation and moderation).

Future plans Current and future research areas include, for example, longitudinal associations between mental health (eg, depressive symptoms, self-esteem) and (1) substance use (alcohol and tobacco), (2) family transitions (eg, parenthood, relationship status) and (3) retirement. Next follow-up is planned to be conducted at the latest at age 62 in 2029. Before that it is possible to link the data with cause-of-death register.

Strengths and limitations of this study

- This cohort covers almost completely one age cohort of one city at baseline and has a long follow-up time covering several life phases from adolescence to midlife in a 36-year follow-up.
- These data have been collected using a holistic perspective and it includes information on physical and mental health, health behaviours, socioeconomic conditions, psychosocial resources, social relationships and support, life events, etc.
- The response rates at follow-ups (52.9%–75.5%) are reasonably good compared with postal surveys in general and 89% of the participants have participated in at least one follow-up.
- The limitations of the cohort include rather long gaps between the follow-ups (6–10 years) and the data confining nearly only to self-reported measures.

INTRODUCTION

The Stress, development and mental health (TAM) cohort was set up to investigate how people experiencing stress and difficulties, could be supported in their development and how to prevent problems in health and well-being.[1] Originally, the cohort study was based on concepts and theories on developmental psychopathology, stress, psychosomatic symptoms and morbidity in the framework of child and adolescent psychiatry and social medicine. In public health research, subjective health had increased interest and this study was built along with this interest. The original study questions in the 1980s dealt with the associations between stress, development and psychosomatic symptoms in adolescence and were examined by the project's long-standing principal investigator professor Hillevi Aro in her PhD project.[2] Not many previous studies on stress and development had focused on adolescents and this study was set up to add knowledge on this developmentally important age phase. Already from the beginning, the aim has been to examine development from a holistic perspective covering several different dimensions of life (eg, health, health behaviour, socioeconomic

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factors, social relationships, psychosocial resources and life events). Some other Nordic longitudinal cohort studies with similar or longer follow-up time have been conducted,[3–5] but in these studies, the starting point has not been mental health perspective. TAM cohort study is particularly focused on mental health (broadly defined) and on the role of risk and protective factors in the development of mental health during the life course, and the data are based on a whole age cohort of one region.

After the 1980s, the focus of the study has been broadened to include a life course perspective. Interest has been on both risk and protective factors[6] and their interplay through the life course and associations with health and especially mental health. Risk and protective factors have included, for example, socioeconomic position (SEP), parental divorce, chronic diseases, psychosomatic symptoms, psychosocial resources and alcohol use. The current and future research areas include various perspectives associated with mental health and its development, for example, substance use (alcohol and tobacco), family transitions (eg, parenthood, relationship status) and retirement. Possibilities to link the survey data with national registers (eg, tax registers, health services) as well as conducting a substudy targeting participants children is at discretion. The project was started at the Department of Public Health in the University of Tampere and later phases have been carried out at the Finnish Institute for Health and Welfare, THL (formerly National Public Health Institute), in Finland.

COHORT DESCRIPTION

The origins of this follow-up study are three school surveys studying psychosomatic symptoms and health behaviour among adolescents that were conducted in 1981–1983 at the Department of Public Health in the University of Tampere (table 1). In these school surveys, the target population included all Finnish speaking eighth (Autumn 1981 and Spring 1982) and ninth (Spring 1983) grade pupils (mainly in 1967 born cohort) attending comprehensive schools in Tampere, an industrial and university city in Southern Finland, with some 166 000 inhabitants at that time. In the 1980s, nearly all Tampere residents were Caucasian and Finnish-speaking (one Swedish-speaking school class was excluded from the cohort). Most people in Finland attend public schools, and very few private schools exist. Educational level among Tampere residents resembled levels in other cities in Finland.[7] The target population was 2287 adolescents in 1981, 2291 in 1982 and 2269 in 1983. The participants of the 1983 survey (n=2194, 96.7%) formed the base population for the follow-up studies (mean age 15.9, SD 0.3) (table 1).

Follow-up information

After the school survey at age 16, the cohort has been followed-up four times using postal questionnaires in 1989 at age 22 (n=1656, 75.5%), in 1999 at age 32 (n=1471, 67.0%), in 2009 at age 42 (1334, 60.8%) and in 2019 at age 52 (n=1160, 52.9%) (table 1). In the first follow-up

Table 1 Target population and response rates in three school surveys and in four follow-ups

Survey	Time	Age	Target population (N)	Number of respondents (N) Total Women Men	Response rate for the target population (%)	Died (N)	Address was available (N)	Response rate for the contacted population (%)
School survey I	December 1981	14	2287	2242 1095 1147	98.0	–	–	–
School survey II	May 1982	15	2291	2191 1074 1117	95.6	–	–	–
School survey III	May 1983	16	2269	2194 1071 1123	96.7	–	–	–
Follow-up I	Spring 1989	22	2194	1656 890 766	75.5	4	2139	77.4
Follow-up II	Spring 1999	32	2194	1471 805 666	67.0	22	2091	70.4
Follow-up III	Spring 2009	42	2194	1334 734 600	60.8	45	2117	63.0
Follow-up IV	Spring 2019	52	2194	1160 648 512	52.9	85	2059	56.3

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0.2%, in the second 1.0%, in the third 2.1% and in the fourth 3.9% had died.

Even though the participation rates have somewhat declined, the response rates are good compared with postal surveys in general.[8 9] Of the age 16 participants 89% has participated in at least one, 74% in at least two, 57% in at least three and 36% in all the follow-ups, while only 11% has not participated in any of the four follow-ups.

Attrition has been studied in more detail at age 32.[10] The results of that analysis showed that the most important predictors of non-response were male gender and poor school performance at age 16 years. These two variables explained away the effect of all other variables at 16 and 22 years on non-response, with the exception of earlier non-response at age 22. Findings of the attrition analyses indicated further that attrition did not bias the estimation of depression prevalence at age 32.[10] Gender and school performance at 16 continued to be prominent predictors of non-response considering the whole follow-up period up to age 52: while parental lower socioeconomic position and divorce, respondent's daily smoking and heavy episodic drinking at age 16 predicted significantly lower number of responses between ages 22 and 52 (range 0–4), their effects were attenuated and non-significant when the effects of gender and school performance were taken into account. During the follow-ups, the participants represented well the whole age cohort in Finland, for example, in terms of marital status.[11] Compared with Finnish population in general, the cohort was more educated, but in comparison to population living in cities, the educational level was similar.[7]

Measures

A summary of the measures in the questionnaires is presented in table 2. Questionnaires are available in English on the cohort's webpages.[12] All measures are self-reported, apart from information on deaths. Data on the deaths of the study participants were provided by Statistics Finland and are linked to the data from the questionnaires using a unique personal identity number. Information on causes of deaths was classified based on the WHO's International Classification of Diseases and Related Health Problems (ICD). In the years 1983–1986 ICD-8[13] was used, in the years 1987–1995 ICD-9[14] was used and from 1996 ICD-10.[15] Changes in the classification system have not changed their comparability.

Characteristics of the participants

The age 52 follow-up characteristics of the TAM cohort are shown in table 3. Majority of the women (61%) had completed high school and 70% had polytechnic level or higher education, while for the men, the respective figures were 49% and 59%. Most participants were working full-time, were married or cohabiting and had children. Most participants (70%) perceived their health good, but one fifth reported depressive symptoms. About 13% smoked daily and a fifth of women and a third of men drank alcohol at least two times a week.

Patient and public involvement

Study participants were not involved in the design, conduct or reporting of the study.

FINDINGS TO DATE

An updated list of publications can be found in the cohort's web pages.[16]

In this project, main interests have been on examining the role of SEP, parental divorce, chronic diseases, psychosomatic symptoms, psychosocial resources and alcohol use on subsequent well-being. Gender differences have been examined in most of the studies. Main findings from some of these domains are reviewed shortly in the following.

Socioeconomic differences

Huurre *et al*[17] examined the direction of association between psychosomatic symptoms and SEP at ages 16, 22 and 32 and found support for both social causation (SEP predicts symptoms) and health selection (symptoms predict SEP) in women, and more for the health selection in men. Lower parental SEP in adolescence was associated with smoking in early adulthood in both genders, not having a physical leisure time activity in early adulthood in males and lower self-esteem and higher BMI at ages 22 and 32 in females after controlling for the person's own SEP.[18] The strongest determinants for a person's educational level at age 32 were school achievement and parental SEP at age 16. In addition, in women, poor self-perceived health, spending less leisure time in hobbies and more on dating and in men, poor relationships with teachers and heavy drinking in adolescence, predicted lower adult educational level at age 32.[19] Regarding SEP, social support and depression, we found that low SEP was associated with low social support from adolescence to adulthood, especially in women. In addition, we found some indications that low level of social support had a greater impact on depression among the lower SEP groups, but this association varied depending on the type of social support, life phase and gender. Social support did not significantly explain SEP differences in depression.[20]

Psychosocial resources

Another important theme in this project has been psychosocial resources and protective factors. For example, good relationships with parents, high self-esteem in adolescence and an intimate relationship protect from subsequent depression in young adulthood.[21 22]

Self-esteem

Results of this study project have also, using latent growth curve models, shown that self-esteem grew linearly between ages 16 and 32, but stopped thereafter. Men had a higher self-esteem throughout the follow-up, but the growth rate was faster in women. Good school achievement at age 16 was associated with higher self-esteem and parental

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Table 2 Summary of the main measures collected on the Stress, development and mental health (TAM) study in seven study phases (1981, 1982, 1983, 1989, 1999, 2009 and 2019)

	Data collected						
Measures	**1981**	**1982**	**1983**	**1989**	**1999**	**2009**	**2019**
Childhood family factors							
Parental SEP, education, employment status	X		X				
Parental divorce, death			X	X	X	X	X
Family adversities (before age 16)						X	
Siblings	X						
Health							
Self-perceived health	X	X	X	X	X	X	X
Chronic illness (list of most common + other)	X		X	X	X	X	X
Psychosomatic symptoms[36]	X	X	X	X	X	X	X
Depressive symptoms (R-BDI[37–39])				X	X	X	X
Mental health (GHQ-12[40])					X	X	X
Psychological distress (K10[41])						X	X
Headache/migraine				X	X	X	
Learning, memory, memory problems						X	X
Use and need of mental health services						X	X
Ability to work until old age pension							X
Height/weight	X	X	X	X	X	X	X
Menstruation	X	X	X	X			
Menopause							X
Health behaviour							
Frequency of alcohol use and heavy episodic drinking		X	X	X	X	X	X
Alcohol use/alcohol disorder (AUDIT[42])					X	X	X
Smoking		X	X	X	X	X	X
Gambling						X	X
Eating behaviours						X	X
Leisure time physical activity		X				X	X
Sleep duration, optimum sleep, chronotype						X	X
Social relationships							
Home atmosphere			X				
Relationship with mother/father			X	X	X	X	X
School class atmosphere, relationship with teacher and classmates			X				
Marital status				X	X	X	X
Dating			X	X	X	X	X
Having children				X	X	X	X
Quality of an intimate relationship				X	X	X	X
Someone to tell about difficulties/perceived availability of social support			X	X	X	X	X
Availability and satisfaction with social support					X	X	X
Size of social network			X	X	X	X	X
Education, occupation, employment							
School achievement		X	X				
Educational plans after ninth grade		X	X				
Basic education, occupational education				X	X	X	X

Continued

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Table 2 Continued

Measures	Data collected 1981	1982	1983	1989	1999	2009	2019
Current occupation, employment status				X	X	X	X
Unemployment (duration, past 10 years)					X	X	X
Spouse's occupation and employment status					X	X	X
Economic situation							
Perceived household subsistence, covering expenses with income, household income						X	X
Housing						X	X
Income support (past 12 months)							X
Psychosocial resources							
Locus of control				X	X	X	X
Social anxiety/sociability					X	X	X
Self-esteem			X	X	X	X	X
Optimism						X	X
Meaningfulness			X	X	X	X	X
Self-image			X				
Satisfaction with different dimensions of life				X	X	X	X
Coping styles				X	X	X	X
Other							
Living arrangements	X	X		X	X	X	X
Hobbies			X	X		X	X
TV usage			X				
Excessive internet use							X
Life events (within past year)			X	X	X	X	X
Helping others (eg, parents)							X
Worries			X				
Imagine life after 5 years from now				X			
Hopes for future			X	X		X	X

AUDIT, Alcohol Use Disorders Identification Test; BDI, Beck Depression Inventory; GHQ, General Health Questionnaire; K10, Kessler Psychological Distress Scale; SEP, socioeconomic position.

divorce among girls and daily smoking among boys were associated with lower self-esteem in adolescence. Daily smoking in adolescence predicted also slower growth in self-esteem among men from adolescence to midlife.[23] In women, higher and increasing BMI was associated with lower and more slowly increasing self-esteem between ages 16 and 42 and these associations got stronger with age.[24] In addition, those who had an increasing number of interpersonal conflicts from adolescence to midlife also had the slowest development of self-esteem.[25]

Parental divorce and family relationships

Those who had experienced parental divorce before the age of 16 had more often in adulthood lower education, more detrimental health behaviours, experienced more negative life events and were more often unemployed and divorced than those whose parents had not separated. Women who had experienced parental divorce had also more often psychological problems and difficulties in relationships at age 32.[26] In addition, parental divorce and poor home atmosphere in adolescence predicted episodic and persistent depression in adulthood.[27 28] Parental divorce was also associated with poorer quality of a person's own intimate relationship at age 32 in women. Psychosocial resources such as mother–daughter relationship, social support and self-esteem partially mediated the association between parental divorce and quality of intimate relationship.[29] By analysing mediation in path analysis, we also found that poor family relationships in adolescence were part of chains of risks all the way to midlife. The pathways from poor family relationships to midlife economic adversity were shaped by low education and poor mental health in adulthood.[30] The pathways from adolescence to poor midlife mental health were mainly shaped by mental health in early adulthood.[31]

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Table 3 Participant characteristics at age 52 follow-up in 2019

	Women (n=648)		Men (n=512)		Total (n=1160)	
Characteristic	**N**	**%**	**N**	**%**	**N**	**%**
Age (mean, SD)	51.9	(0.33)	51.9	(0.37)	51.9	(0.35)
Basic education, completed high school						
Yes (12 years)	392	60.7	250	49.0	642	55.5
No (9 years)	254	39.3	260	51.0	514	44.5
Highest level of education						
University level	152	23.6	123	24.2	275	23.9
Polytechnic or equivalent institution	299	46.4	177	34.8	476	41.3
Vocational school or less	194	30.1	208	40.9	402	34.9
Employment status						
Working full-time	511	79.0	431	84.7	942	81.5
Working part-time	50	7.7	13	2.6	63	5.4
Unemployed	42	6.5	26	5.1	68	5.9
Disability pension, retired or long-term sick leave	27	4.2	31	6.1	58	5.0
Other	17	2.6	8	1.6	25	2.2
Household income (EUR)						
0–1999	91	14.2	62	12.2	153	13.4
2000–3999	232	36.3	153	30.2	385	33.6
4000–6999	257	40.2	223	44.0	480	41.9
7000–	59	9.2	69	13.6	128	11.2
Housing						
Owner-occupied flat/house	513	79.3	413	81.3	926	80.2
Right of residence apartments or part-ownership dwelling	20	3.1	13	2.6	33	2.9
Rented flat	110	17.0	79	15.6	189	16.4
Other	4	0.6	3	0.6	7	0.6
Marital status						
Unmarried	76	11.7	69	13.5	145	12.5
Married	387	59.7	316	61.7	703	60.6
Cohabiting	93	14.4	84	16.4	177	15.3
Divorced or separated	82	12.7	42	8.2	124	10.7
Widowed	10	1.5	1	0.2	11	0.9
Having children						
0	121	19.1	100	19.8	221	19.4
1	86	13.6	77	15.3	163	14.3
2	233	36.8	167	33.1	400	35.1
3 or more	194	30.6	160	31.7	354	31.1
Good self-perceived health†	466	72.6	341	66.7	807	70.0
Depressed*	146	22.5	80	15.7	226	19.5
Body mass index (mean, SD)	27.3	(5.52)	28.2	(4.75)	27.7	(5.21)
Daily smoking	84	13.0	70	13.9	154	13.4
Alcohol use						
2 times/week or more often	124	19.2	166	32.5	290	25.1

*Short 13-item Beck Depression Inventory score ≥5.
†Self-perceived health 'rather good' or 'very good'.

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Alcohol use

This study has also examined alcohol use from various perspectives. The most important determinants for age 32 alcohol use were male gender, parental divorce (before age 16), depressive symptoms, spending a lot of leisure time with friends and frequent and heavy episodic drinking at age 16.[32] Five different trajectory groups of heavy episodic drinking from adolescence to midlife were identified using latent class growth analysis. The steady high and in men also increasing heavy drinking were associated with various disadvantages in midlife.[33] A study examining development of psychological symptoms and heavy drinking from adolescence to midlife combined latent class analysis and latent growth modelling and concluded that the more the drinking trajectory indicated frequent heavy drinking, the higher was the level of symptoms throughout the follow-up. Results of cross-lagged autoregressive analysis support the self-medication hypothesis, suggesting that alcohol is used to ease the burden of psychological symptoms.[34]

In conclusion, the results of these various studies show that adolescent risk and protective factors have long-lasting mental health and well-being effects into adulthood. However, these effects seldom work directly, but by intertwining with later risk and protective factors and via various life course mechanisms such as accumulation and chain of risks.[35]

Strengths and limitations of this study

The main strengths of this study are an almost complete coverage of one age cohort of one city at baseline and the long follow-up time covering several life phases in a 36-year follow-up. The follow-up can be continued even further. Another strength is a rather holistic perspective covering several different dimensions of life. The data can be used to address many cross-disciplinary study questions. However, if the study would be initiated now, more detailed information on the childhood and family conditions and well-being (before age 14) would likely be covered.

Although there is attrition, the follow-up rates are reasonably good compared with postal surveys in general. Nevertheless, attrition (mainly related to male gender and poor school achievement) needs to be taken into account when interpreting the findings. However, the high participation rate at baseline (practically comprising the whole target group), enables elaborate examination of attrition (see reference[10]).

All the measures (except mortality) are self-reported and thus prone to the general problems of self-reporting. For example, clinical interviews would have provided more detailed information on the diagnoses of mental disorders. In addition, when the theoretical perspectives have widened, we have included some new validated measures in the follow-ups. Thus, we do not have all the information from every study phase and there have been some changes in the measures.

Collaborators The TAM data are stored and maintained at the THL in Finland. These data are not freely available due to legal restrictions and the nature of the data. Suggestions for collaboration are welcome. The main contact persons are research manager Olli Kiviruusu, at olli.kiviruusu@thl.fi and senior researcher Noora Berg, at noora.berg@thl.fi.

Contributors NB drafted the manuscript, with contributions from OK and JG. All authors commented on the manuscript. NB, JG, TH, OK and MM participated in the acquisition and interpretation of data. MM acted as the PI for the cohort. OK was responsible for data management and analyses. All authors reviewed and approved the final version of the manuscript. NB acted as the guarantor for this work.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting or dissemination plans of this research.

Patient consent for publication Not required.

Ethics approval The study protocol was approved by the Ethics Committee of Tampere University Hospital and the Institutional review board (IRB) of The Finnish Institute for Health and Welfare (THL) (formerly National Public Health Institute). Participants were informed of the purposes of the study and that participation was voluntary. They were requested to indicate their consent by answering the survey questionnaire.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. The data cannot be placed on a public repository or given as supporting files due to legal restrictions and the nature of the data (individual level data). Although the data have been analysed as pseudonymised, the original code for linking the data with participants exists (stored separately) and has not been destroyed for follow-up purposes. Individual-level data cannot be made publicly available in case the original linkage can still be retrieved, even though the actual linking information would not be made public. Suggestions for scientific collaboration are welcome. Data requests are reviewed in the Finnish Institute for Health and Welfare for compliance with the original research purposes of the study project. Suggestions for collaboration may be sent to: Noora Berg or Olli Kiviruusu, Finnish Institute for Health and Welfare, PO Box 30, 00271 Helsinki, Finland (contact: noora.berg@thl.fi/ olli.kiviruusu@thl.fi).

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